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# CURRICULUM GUIDE
# FOR
# SENIOR HIGH SCHOOL

# MATHEMATICS 30

September, 1967

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## ACKNOWLEDGEMENT

The Department of Education acknowledges with appreciation the contributions of the subcommittee members, and ad hoc committee members to the preparation of the Curriculum Guide for Mathematics 30. The subcommittee operated under the guidance of the Senior High School Committee.

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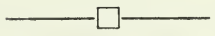
## OBJECTIVES OF THE SENIOR HIGH MATHEMATICS PROGRAM



While the academic, vocational and commercial sequences of courses have different specific objectives the common general purposes of Senior High School Mathematics courses are as follows:—

1. To develop an understanding of mathematics as a creation of man and to develop an appreciation of the contribution of this discipline to the progress of civilization.

2. To develop precision in thought and expression.

3. To develop and maintain an understanding of the operations and concepts of mathematics.

4. To develop and maintain skill in mathematical operations.

5. To develop powers of logical analysis of problems and to present their solution in a clear and precise manner.

## MATHEMATICS 30

### Objectives of Mathematics 30

The general objectives of high school mathematics programs stated above apply to Mathematics 30. Following is a statement of the more specific objectives of this course:

1. To review algebraic concepts of previous courses.
2. To expand the student's concept of function.
3. To investigate further the quadratic relation.
4. To extend the student's understanding of number systems through the introduction of complex numbers.
5. To introduce the student to some aspects of combinatorial mathematics:— selections, arrangements, and probability.
6. To develop an understanding of the basic concepts of descriptive statistics.

### COURSE OUTLINE FOR MATHEMATICS 30

Prerequisite: "B" or better standing in Mathematics 20.

Text:

SECONDARY SCHOOL MATHEMATICS, GRADE TWELVE, Edition Two, MacLean et al.

Teacher References:

1. Elliot, Fryer, Gardner, Hill: ALGEBRAIC STRUCTURES AND PROBABILITY; (Holt, Rinehart & Wilson)
2. Elliot, Fryer, Gardner, Hill: FUNCTIONS, RELATIONS, AND TRANSFORMATIONS: (Holt, Rinehart & Wilson)
3. Mosteller, Rourke, Thomas; PROBABILITY AND STATISTICS; (Addison-Wesley)

These references may be obtained from the School Book Branch, 10410 - 121 Street, Edmonton, Alberta.

NOTE:

It is recommended that students use mathematical tables whenever possible. Teachers should encourage students to obtain individual copies of KNOTT'S MATHEMATICAL TABLES (revised edition) or CASTLE'S FIVE-FIGURE LOGARITHMIC AND OTHER TABLES and should give instruction in the use of these tables.

| CONTENT: | Time Schedule |
|---|---|
| 1. Basic Language of Mathematics | — 1 week |
| 2. Real Numbers, Real Function (Chapter 1) | — 5 weeks |
| 3. Sequences and Series and Mathematical Induction (Chapter 3—omitting 3.14) | — 6 weeks |
| 4. Complex Numbers (Chapter 4—omitting sections 4.14 to 4.20 inclusive) | — 4 weeks |
| 5. Quadratic Relations (Chapter 5) | — 5 weeks |

6. Sets, Arrangements and Selections, Binomial Theorem (Chapter 6) — 5 weeks
7. Introduction to Probability (Chapter 7) — 6 weeks
8. Random Variables and Descriptive Statistics (Chapter 8—omitting 8.15) — 0 weeks

The suggested time schedule above provides broad limits for teaching the course. Since the topics of quadratic relations and probability will be new to some teachers, generous time allotments have been suggested for these sections. No time allotment has been suggested for the topic "Random Variables and Descriptive Statistics" since the material is optional for an interim period. The total of thirty-two weeks allows for testing and review.

It should be noted that some sections marked "supplementary" in the text are included in the course.

## SUGGESTIONS FOR TEACHING MATHEMATICS 30
(Effective September, 1967)

The teacher should be continually aware of the general objectives of the senior high school mathematics program and the specific objectives of the Mathematics 30 course. Such an awareness will give direction to each lesson and consequently to the whole program.

In addition to the general time schedule for the entire course, a suggested time schedule for each chapter is provided. For the purposes of this guide a period is defined as being forty minutes in length.

As is the case in the teaching of any course, careful preparation is essential. This is especially true when teaching a course for the first time. It is suggested that teachers survey the complete course noting the topics included and their interrelationships. As a result of such a survey, teachers may feel that some form of group study at the staff or district level would be advantageous. Before beginning a new section it is advisable to study the whole chapter in detail.

Certain sections of the course—e.g. **Selections, Arrangements and Probability** provide opportunities for a variety of class projects. Teachers are encouraged to carry forward these and other projects for approaching concepts through a variety of ways is sound pedagogy. In this connection a variety of teaching procedures—discovery exercises, individual study, laboratory lessons, guest lecturers, etc. is recommended.

In order to give some guidance to teachers, especially those using the text for the first time, exercises are labelled A, B, or C to give some indication of their difficulty. A few of the B exercises and all of the C exercises tend to be quite demanding. Teachers should exercise discretion in assigning such exercises to the whole class. While it is true that final examinations tend to include one or more very difficult exercises in order to give the outstanding students an opportunity to display their ability, it is questionable whether, for the average student, spending much class and homework time on such exercises contributes to the objectives of the course.

## BASIC LANGUAGE OF MATHEMATICS

The main topics are

1. Atomic sentences, molecular sentences, sentential connectives.
2. Equivalent statements.
3. Quantifiers.

*Comments:* This chapter reviews some of the basic language of the course. It is not intended that the chapter be extended to become an introduction to logic. Teachers should use opportunities as they arise through the course to refer back to this basic language and to review the symbolism connected with it. Teachers should use the development under equivalent statements to review the solutions of conditions, particularly those involving radicals, logarithms, and exponents. This will require additional examples to those in Exercise 2 (B).

Suggested Time Schedule:

| | |
|---|---|
| Section 1 | — 1 period |
| Section 2 | — 3 periods |
| Section 3 | — 1 period |

## CHAPTER 1

The main topics are

1. Number systems and their properties.
2. Algebraic systems and their properties—groups, fields.
3. Relations.
4. Functions and their Inverses.
5. Special Functions—linear, quadratic and cubic.
6. Problem solving requiring the use of linear and quadratic conditions —maximum and minimum problems.

*Comments*: This chapter reviews the important concepts relating to relations and functions of the Mathematics 20 course. Very few new ideas are introduced. The properties of some algebraic systems—groups and fields—are studied. The real number system is developed as an ordered field. To be an effective review of relations and functions the material should be carefully organized since the content of several chapters of the Mathematics 20 course has been compressed into a single chapter here. Discuss the development of the various number systems as extensions from the natural numbers concluding with the real number system as an example of an ordered field.

Suggested Time Schedule:

| | |
|---|---|
| Sections 1.1 - 1.2 | — 5 periods |
| Section 1.3 | — 3 periods |
| Sections 1.4 - 1.5 | — 4 periods |
| Section 1.6 | — 3 periods |
| Section 1.7 | — 5 periods |
| Section 1.8 | — 2 periods |
| Review and Testing | — 3 periods |

## CHAPTER III: SEQUENCES AND SERIES

The main topics are:

1. Sequences defined recursively.
2. Arithmetic sequences.
3. Geometric sequences.
4. Sum of a finite arithmetic series.
5. Sum of a finite geometric series.
6. Application of series to annuities.
7. Mathematical induction.

*Comments:* An infinite sequence is defined as a function whose domain is the set of positive integers, and whose range is a subset of the real numbers or complex numbers. The sum of the terms of an infinite sequence is defined as an infinite series. Teachers should be careful to make this distinction. The ability to define any sequence recursively is important, and occurs frequently in the chapter. Inductive reasoning used to predict the sum to "n" terms of a given series provides excellent background for the study of mathematical induction.

Suggested Time Schedule:

| | |
|---|---|
| Sections 3.1 - 3.2 | — 4 periods |
| Section 3.3 | — 2 periods |
| Section 3.4 | — 2 periods |
| Sections 3.5 - 3.6 | — 3 periods |
| Section 3.7 | — 2 periods |
| Section 3.8 | — 3 periods |
| Sections 3.9 - 3.12 | — 5 periods |
| Sections 3.13 | — 5 periods |
| Review and Testing | — 2 periods |

## CHAPTER IV: COMPLEX NUMBERS

The main topics are:

1. Complex numbers.
2. Equality in C defined.
3. Operations in C defined.
4. Identity elements.
5. Inverse elements.
6. The real numbers as a subset of C.
7. Geometric representation of complex numbers.
8. The absolute value of a complex number.
9. The distance between two points in the complex plane.
10. Applications of complex numbers to the solution of quadratic equations.

*Comments:* In this section the set of complex numbers is developed as an extension of the real number system. The two binary operations, addition and multiplication, are defined. The properties of the set of complex numbers under the two operations are examined, leading to the conclusion that the set constitutes a

field but not an ordered field. As a real number is represented by a point on a line, so a complex number is represented as a point on the complex plane. A formula representing the distance between two such points is determined.

Suggested Time Schedule:

| | |
|---|---|
| Sections 4.1 - 4.2 | — 1 period |
| Sections 4.3 - 4.4 | — 1 period |
| Sections 4.5 - 4.8 | — 6 periods |
| Sections 4.9 - 4.11 | — 3 periods |
| Sections 4.12-4.13 | — 5 periods |
| Testing and review | — 2 periods |

## CHAPTER V: QUADRATIC RELATIONS

The main topics are:

1. The circle.
2. The parabola.
3. The ellipse.
4. The hyperbola.
5. Asymptotes of an hyperbola and pairs of straight lines.
6. Linear quadratic systems.

*Comments:* A review of the following topics from Mathematics 20 may be useful: Conditions for parallelism and perpendicularity; midpoint formula; distance formula; chord property theorems; tangent property theorems.

The chapter presents six basic theorems pertaining to the conics. Other than for the circle and parabola, the center is always at (O,O) with axes of symmetry the x-axis and y-axis.

Sugested Time Schedule:

| | |
|---|---|
| Sections 5.1 - 5.3 | — 5 periods |
| Sections 5.4 - 5.7 | — 5 periods |
| Sections 5.8 - 5.10 | — 4 periods |
| Sections 5.11 - 5.13 | — 3 periods |
| Sections 5.14 - 5.16 | — 3 periods |
| Section 5.17 | — 3 periods |
| Review and testing | — 1 period |

## CHAPTER VI: ARRANGEMENTS AND SELECTIONS

The main topics are:

1. Multiplicative counting principle for sets.
2. Arrangements.
3. Binomial coefficients.
4. Selections as subsets of a set.
5. Sigma notation.

*Comments:* Teachers who have taught previous Mathematics 30 courses will find it necessary to become familiar with the new notation and new terminology.

$(n)_r$ is an r-arrangement of n different objects $(O \leq r \leq n, n \in N)$;

$\frac{n}{r_1, r_2, r_3, \ldots r_k}$ is the number of n-arrangements of n things, $r_1$ of which are alike of one kind, $r_2$ of which are alike of a second kind, . . . . $r_k$ of which are alike of kth kind;

$\binom{n}{r}$ represents the number of r-subsets of a given set.

Suggested Time Schedule:

| | |
|---|---|
| Sections 6.1 - 6.3 | — 3 periods |
| Section 6.4 | — 3 periods |
| Sections 6.5 - 6.7 | — 5 periods |
| Section 6.8 | — 3 periods |
| Sections 6.9 - 6.10 | — 4 periods |
| Section 6.11 | — 2 periods |
| Review and testing | — 2 periods |

## CHAPTER VII: INTRODUCTION TO PROBABILITY

The main topics are:

1. Experiments and their sample spaces.
2. Relative frequencies and empirical probability.
3. Probability as an additive set function.
4. Mutually exclusive events.
5. Conditional probability.
6. Independent events.
7. Independent binomial trials.
8. Binomial probability tables.

*Comments:* The theory of probability as developed by Pascal and Fermat is quite satisfactory where simple outcomes have equal possibilities. It is not so satisfactory when outcomes do not.

The treatment in the text is based mainly on two ideas: that of an additive set function and that of a sample space. The term "additive set function" has not been mentioned previously and might be defined as a function the elements of whose domain are sets and the elements of whose range are real numbers and which has the properties illustrated by problems 3, 4 and 6 of Exercise 6-1. Thus the particular additive set function, n(A), has been introduced, although it has not been given that name.

In connection with the idea of a sample space, it is necessary to note that the same experiment may give rise to more than one sample space. If the experiment is the rolling of two dice, for example, one sample space is the set of 36 ordered pairs in problem 2 of Exercise 7-1. Other sample spaces are {2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12}, {alike, different}, {even sum, odd sum}. The first of these four sam-

ple spaces is the most fundamental since it allows a finer distinction between outcomes but one of the others may be more convenient to use in a particular problem.

Suggested Time Schedule:

| | |
|---|---|
| Sections 7.1 - 7.2 | — 3 periods |
| Sections 7.3 - 7.5 | — 5 periods |
| Sections 7.6 - 7.7 | — 5 periods |
| Sections 7.8 - 7.9 | — 5 periods |
| Section 7.10 | — 3 periods |
| Sections 7.11 - 7.12 | — 4 periods |
| Review and testing | — 2 periods |

## CHAPTER VIII: RANDOM VARIABLES and DESCRIPTIVE STATISTICS

NOTE: This chapter will be optional for an interim period. Material from this chapter will not be included on the departmental examination.

The main topics are:

1. Random variables and probability distribution.
2. Tabulation and classification of data.
3. Graphical representation of statistical data.
   — Relative frequency histograms
   — Probability density functions.
4. Measures of location; the mean, median and mode.
5. Measures of dispersion or variability:
   range, interquartile range, standard deviation.

*Comments:* Much ground is covered in this chapter and because of the lack of calculus, some formal proofs are omitted. One gets the impression that the authors are only hitting the high spots. Students will probably find section 8.2 difficult to read and understand. It might be advisable to summarize as follows:

1. A random variable is a function.
2. Like an additive set function it maps the set S into the set of real numbers.
3. The range of the function; i.e. the particular set of real numbers resulting from the mapping, rather than the function itself, is often called the random variable.
4. An example of a random variable is the probability distribution function: $b(x; n,p)$ which equals

$$\left(\frac{n}{x}\right) p^x q^{n-x}, \quad (x = 0, 1, 2, \ldots n)$$

Suggested Time Schedule:

| | |
|---|---|
| Sections 8.1 - 8.2 | — 3 periods |
| Sections 8.3 - 8.5 | — 3 periods |
| Section 8.6 | — 1 period |

| | |
|---|---|
| Sections 8.7 - 8.9 | — 3 periods |
| Section 8.10 | — 1 period |
| Section 8.11 | — 1 period |
| Section 8.12 | — 2 periods |
| Section 8.13 | — 1 period |
| Section 8.14 | — 3 periods |
| Review and testing | — 2 periods |

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